Chapter Five

Prevention at Educational Institutions: Engaging Future Leaders

- **K-12 Programs**
- **University-level Programs**
- **Guest Comments:**

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Introduction

Prevention programs can start as early as elementary school and extend into graduate school programs. Educational institutions at all levels are making great strides in developing and incorporating pollution prevention programs. Students in grades K-12 are learning about pollution prevention through projects designed to foster environmental stewardship. At the college level, students are offered a growing number of courses in environmental studies. In addition, universities are beginning to develop a multidisciplinary approach to pollution prevention and conservation. Environmental concepts are being incorporated into a wide variety of courses from urban planning to economics. Students, faculty, and staff are active in developing and participating in campus pollution prevention programs and related research and development. Many colleges and universities have committed to a leadership role in pollution prevention. Faculty are using information technology to help identify and transfer pollution prevention information. The nation's educational institutions are engaging in technical assistance programs and partnership programs with industry and government.

Prevention programs can start as early as elementary school and extend into graduate school programs.

The growth of pollution prevention programs in educational institutions has been helped by two laws passed in 1990 — the National Environmental Education Act and the Pollution Prevention Act. Both these acts helped build a framework for integrating pollution prevention into educational programs across the United States.

The National Environmental Education Act of 1990 focused attention on the need for incorporating environmental awareness into the educational system from kindergarten through grade 12 and beyond. The Act also charged EPA with the responsibility for coordinating federal environmental education initiatives at the national level. In response, EPA established an Environmental Education Division to advance and support national education efforts to develop an environmentally conscious and responsible public. Among the programs started are environmental education grants, an environmental teacher-training program, the National Network for Environmental Management Studies Fellowship Program, and the Native American Scholarship Program. Congress also created a nonprofit organization, the National Environmental Education, and Training Foundation to foster partnerships between the public and private sectors to fund and develop environmental education programs and initiatives.

By recognizing source reduction as the nation's preferred approach to environmental protection, the Pollution Prevention Act of 1990 has stimulated educators' efforts to raise student awareness about source reduction. Under the Pollution Prevention Act, EPA has supported schools, universities, and nonprofit organizations in developing innovative ways to incorporate pollution prevention ideas into educational initiatives.

What is new in educational initiatives in pollution prevention is the emphasis on waste reduction rather than the traditional curriculum concentrating on natural resource con-

servation and recycling. Source reduction and pollution prevention concepts encourage students to think differently about pollution and their own roles in preventing environmental degradation. Students begin to appreciate the life cycle of products they use on a daily basis and consider the environmental implications of routine decisions they make.

This chapter describes some of the most successful pollution prevention programs and activities in U.S. educational institutions. The chapter is organized into two sections:

- K-12 Programs
- University-level Programs, which include both internal activities (pollution prevention, curriculum development, faculty research and development, campus pollution prevention programs) and external programs (technical assistance programs, partnership programs, community and facility audits). A prevention training program targeted toward community college students is also described in this section.

K - 12 Programs

In the 1970s, environmental education programs emphasized natural resources conservation and environmental impacts. As neighborhood recycling programs became increasingly common in the late 1980s, educators began recycling in their classrooms as a way of involving students in activities that preserve the environment. In the early 1990s, educators began integrating pollution prevention into the curriculum. This was accomplished with a diverse selection of increasingly sophisticated interactive tools, games, and activities to stimulate students' appreciation and understanding of basic ecology and conservation principles. Drawing on these resources as a starting point, educators have taken pollution prevention to its logical conclusion by discussing source reduction as the best way to reduce the consumption of natural resources and minimize environmental impacts.

In some cases, educators teach source reduction and recycling concepts in the context of a natural resource issue that hits home. For example, 105 fifth graders at Clark Elementary School in Spring, Texas are saving their city 575,000 gallons of ground water annually. Along with 55,000 other students in the upper Gulf Coast area, they are participants in a program called "Learning to Be Water Wise and Energy Efficient" created by the nonprofit educational group, the National Energy Foundation. The program combines classroom discussion, problem solving in math and science, and creative activities with "homework"— high efficiency plumbing fixtures, which are taken home, installed, and monitored. Implemented in the Harris-Galveston Coastal Subsidence District on a full-scale basis in the 1994-95 school year, the program is being sponsored by public water suppliers in partnership with local elementary and intermediate schools.[1]

[1] EPA, "Water-Wise Students Bring Home Savings," *Pollution Prevention News* (September/October 1995).

In May 1997, nineteen groups of students from around the country were honored with the 1995 and 1996 President's Environmental Youth Awards.[2] These awards recognize students who take a leadership role in learning about and protecting the environment in their local communities. Among the winners was a group of high school students in Tulare, California that converted an unused portion of a school parking lot into a mini-park for the school and the community. Students in the Environmental Biology classes planned and completed the project over five years, and each class had a distinctive role, from concept development and initial planning to solicitation of materials, pavement removal, earth moving and landscaping. Presiding over the new park is a larger-than-life statue, commissioned by the students, of Chief Seattle who is known for his words, "The earth does not belong to man. Man belongs to the earth."

A consortium of organizations is cooperating on a project to develop an environmental education program that targets middle/junior high school students in the State of New

Necessary Wrapper? Activity

Purpose: To help students realize that large amounts of packaging may be used to wrap products they buy. Some packaging is needed to protect the product, but how much is enough?

Grade level: K through 3

Focus: One out of every $11 is spent on product packaging in the United States. We have gotten into the habit of buying items for convenience, without thinking about how much or what we throw away. In this exercise, find out how much waste is from packaging.

Procedure:

1. Ask children to unwrap the product, saving all packaging.
2. Weigh pile of packaging and pile of product. Which weighs more, the product or the packaging?
3. Ask the children why there are so many wrappers and try to identify a use for each. How would the children package the product?
4. Have the children identify the source of the raw materials for the packaging, i.e., the plastic, aluminum, paper.
5. Ask the children to think of other things that their families buy that come in packages.

Enrichment:

- Discuss if we reduce the amount of packaging, will we reduce the amount of garbage? What packaging is easily recycled, what is difficult to recycle?
- Discuss what everyone can do to help, such as buying items in bulk and then dividing it, buying easily recycled materials, letting stores know if there are overpackaged items such as vegetables, meats, or convenience foods.
- Write letters to companies that are overpackaging.

Source: *Composting in Schools* produced by Cornell University Program in Environmental Sciences for Educators and Youth, 1997 (www.cfe.cornell.edu/compost/schools.html)

[2] EPA Press Release "Nineteen Student Groups Honored with the President's Environmental Youth Awards" (May 23, 1997).

York. The program's goal is to call attention to Great Lakes environmental issues. This public/private partnership brings together the support of Niagara Mohawk Power Corporation, National Audubon Society, Inc., and EPA, working with Earth Generation, Inc., a private developer/facilitator of environmental education programs.

Under the program, Earth Generation will develop 10 projects that center around the following four key issues:

- Achieving Air Quality
- Preserving Water Quality
- Living for the Ecosystem
- Caring for the Land

Three of the four issues (1, 2 and 4 above) specifically discuss pollution prevention as a problem solving approach.[3] Similar projects are already in use in Michigan and Arizona.

E2 (Environment and Education) is a nonprofit organization that aims to provide future generations with environmental knowledge and tools necessary to make changes toward a sustainable future. This organization has developed an activity-based curriculum**,** *Environmental ACTION*, that teaches students how to prevent pollution in their school and home environments. The program targets students in middle schools and high schools to investigate human health, resource consumption, and environmental issues and practice taking actions for improvement. *Environmental ACTION* responds to needs for environmental education activities that emphasize personal responsibility and positive action to prepare students to participate actively in conservation efforts. The curriculum consists of several modules, including the following:

1. *Energy Uses & Conservation* - students explore energy production, use, and environmental effects. Using the school as a research laboratory, students examine how to improve the energy efficiency of their schools and homes.

2. *Source Reduction & Waste Management* - students sort and analyze their school's garbage to identify recyclable and compostable materials. They formulate a plan to reduce their consumption and waste at school and home. The development or improvement of an existing recycling program is part of the process.

3. *Water Quality & Conservation* - after an introduction to water consumption and quality issues, students conduct an audit of water usage and efficiency on the school campus. Then they develop strategies for conserving water at school and home.

[3] Earth Generation, Inc. As printed in EE-Link, the web site for the National Consortium for Environmental Education and Training. For further information, contact Earth Generation at 517-631-4010 (E-mail: EarthGen@aol.com).

4. *Habitat & Diversity Enhancement* - students investigate the types of toxic materials, chemical products, cleaning supplies, and pesticide practices used in their school, how they are stored and disposed of, and what their potential effects are on human health and the environment. After evaluating the results, students develop a plan for using "earth and human-friendly" alternatives at school and home.[4]

The National Consortium for Environmental Education and Training has created a gopher and web site for environmental education called *EE-Link (*http:/eelink.umich.edu). *EE-Link's* mission is to spread information and ideas that will help educators explore the environment and investigate current issues with students. The target audience is teachers and others who support K-12 environmental education such as media specialists, in service providers, nature centers, and curriculum developers.

Spurred by legislation at the federal, state, and local levels, the field of environmental education is rapidly expanding both in the United States and world-wide. Organizations such as the EPA-funded Environmental Education and Training Partnership Project are accelerating the pace of environmental education through improved information transfer, basic training materials, and training for educators. Building on these and similar activities, and well-rooted curricula in ecology and resource conservation, educators have begun interweaving prevention concepts into course materials and activities. K-12 students are changing the way their schools and communities resolve environmental issues as a result of their hands-on experience and familiarity with pollution prevention.

University-level Programs

Nationwide, colleges and universities have begun to embrace pollution prevention as well. Universities play an important role not only in educating future leaders but also as centers for research and development for creating and exchanging new pollution prevention technologies. Many centers go beyond engineering research and development and provide forums for regulators, businesses, and local communities to come together to resolve environmental issues through pollution prevention. Colleges and universities have internalized pollution prevention and are making broad sweeping institutional changes to reduce environmental impacts and consumption of natural resources on their campuses.

Pollution Prevention Curriculum Development

In the 1970s, colleges and universities began establishing environmental science/studies departments in order to meet the demand for trained environmental professionals. However, course work in environmental science was often not integrated with other disciplines.

[4] *Environmental Action* modules will be published beginning in late fall 1996 through 1997 by Addison-Wesley Longman. For further information, contact E2 at 310-573-9608 (E-mail: e2@earthspirit.org).

The work of incorporating pollution prevention ideas into the curricula of college-level courses has been taken up by profit organizations and a handful of individual instructors. Concepts of source reduction and recycling were initially integrated in the science and engineering departments but have since spread to business schools and even to liberal arts programs. Several well-known universities are in the forefront of this effort, including: the University of Michigan, the University of Massachusetts - Lowell, and the Florida Institute of Technology.

The National Pollution Prevention Center (NPPC) at the University of Michigan offers many tools and strategies to incorporate pollution prevention concepts into the curricula of universities and colleges for faculty, students, and professionals.[5] The NPPC publishes Pollution Prevention Educational Resource Compendia in a variety of disciplines, including business law, chemical engineering, chemistry, accounting, industrial engineering/operation management, agriculture, architecture, and strategic management. Each compendium offers a discipline-specific resource list (which is available on the World Wide Web at http://www.UMich.edu/nppcpubResLists/), an annotated bibliography, selected readings, syllabi, and assignments. Course compendia and other educational materials being developed by the NPPC are based on a systems approach to pollution prevention. In addition, the NPPC offers a unique national internship program that provides practical experience to undergraduate and graduate students in waste prevention process assessments. Students participating in the internship program work directly with an organization and a faculty mentor who provides academic guidance for the work experience.

Case studies are a popular way of "greening" the curriculum of business schools. Many of the case studies being developed by Harvard Business School, WRI/MEB, NPPC, and other organizations are based on real-life examples of the intersection of environment and business. At the same time, they offer a richness of detail for students to ponder. Examples of WRI/MEB case studies include:

- A simulation exercise involving hydropower and salmon in the Columbia River Basin that illustrates the complex nature of sustainable development.
- A classic example, based on AT&T's Columbus Works plant, of how total quality management techniques can be used to eliminate environmental hazard.
- A case study of Industrial Products, Inc. That examines managers' efforts to design and implement a system for measuring the environmental impacts of its operations.

The NPPC publishes a *Directory of Pollution Prevention in Higher Education: Faculty and Programs* in order to help build a national network of pollution prevention educators who can contact each other to share information, ideas, and curricula. The first edition, published in 1992, contained 89 faculty members. The second edition, published two years later, contained 127 more entries bringing the total to 216 faculty.

[5] The National Pollution Prevention Center for Higher Education. Program brochure. Additional information on NPPC can be obtained via the web site: http://www.snre.umich.edu/nppc/ or by calling 313-764-1412.

A number of organizations are promoting environmental business education courses for undergraduates, graduate students, and business executives. Since 1990, the Management Institute for Environment and Business (MEB) has worked with business schools to facilitate an understanding of environmental issues in MBA programs. For instance, the Business-Environmental Learning and Leadership Program (BELL) is a consortium of 25 business schools working with MEB to assemble environmental courses on their campuses.[6] The BELL Best Management Practices course centers on environmental management techniques used by leading companies, such as environmental accounting, design for environment, pollution prevention, life-cycle analysis, and quality management.

In October 1996, MEB merged with the World Resources Institute (WRI), a center for policy research and technical assistance on environment and development issues. By merging business and economics expertise, WRI now does work relevant to business audiences in environmental accounting, performance measurement, capital markets, forestry, biodiversity, and climate change. The new merged organization will continue programs such as BELL and will launch new educational initiatives that will incorporate both environmental leadership, technology and economics, and science and policy.[7]

Faculty from the science and engineering departments of colleges and universities across the country have prepared problem sets and new courses devoted exclusively to preventing pollution and have woven prevention concepts into existing courses. Engineering faculty teach students how to incorporate pollution prevention in process design (Design for Environment), and also how to spot opportunities for waste reduction in unit operations. Life cycle analysis is another active area of research in which universities are engaged, often as a cooperative research effort with EPA.

As universities have recognized the need for an interdisciplinary approach to environmental studies, they realize that faculty must be prepared to teach these new courses. The Tufts Environmental Literacy Institute (TELI) broke new ground in 1990 by offering interdisciplinary *professional development* on environmental issues for university and secondary school faculty. TELI training equips faculty to teach environmental issues both from an interdisciplinary perspective and with specific reference to their own fields.[8]

The Montana State University Extension Service Pollution Prevention Program recently developed a new education guide for Native American colleges. This educational tool kit for tribal colleges, developed with the guidance of Native American educators, includes lesson plans, student guides, instructional materials, and tests and

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[6] For more information on the BELL program contact WRI/MEB at 1709 New York Ave., NW, (7th Floor) Washington, DC 20006 or call 202-638-6300.

[7] *EnviroLink: A Newsletter for Educators in the Field of Business and the Environment* (Spring 1996).

[8] Keniry, J. *EcoDemia: Campus Environmental Stewardship at the Turn of the 21st Century*. National Wildlife Federation, Washington, DC (1995). p. 194.

evaluations. It is designed to be used alone as a new course of study or to complement an existing natural resources curriculum.[9]

In 1992, the American Institute for Pollution Prevention, together with the American Institute of Chemical Engineers and the Center for Waste Reduction and Technologies, published a compendium of homework and design problems for engineering students geared toward pollution prevention issues.[10]

Research and Development

NPPC has focused its research program solely on life cycle design, life cycle assessment, and industrial ecology. The program's goal is to guide and enhance environmental decision making through effective metrics, identification and analysis of key stakeholder requirements, and selection of resource conservation and pollution prevention strategies.

The NPPC also has been involved in demonstration projects sponsored by the EPA National Risk Management Research Laboratory for the testing and refinement of life cycle design techniques. These demonstration projects between the NPPC, EPA, and industrial partners have targeted a wide range of products. Automotive products investigated include oil filters (Allied Signal), air intake manifolds (Ford), fuel tanks (GM), automotive film (3M), and instrument panels (Chrysler, Ford, GM, EPA Common Sense Initiative). Electronic products include business telephones (AT&T), flat panel displays (Optical Imaging Systems), and photovoltaics (United Solar Systems). Other systems studied range from milk and juice packaging (Dow), to wet technologies for garment cleaning.

Carnegie Mellon University developed a university-wide pollution prevention research effort, the Green Design Initiative (GDI) (see text box). The GDI consists of interdisciplinary teams whose goal is to prepare new environmental management and pollution prevention tools for product and process design, policy, and environmental management. Two main goals are pursued in developing green technologies and policies: (1) minimize and effectively manage the use of resources and (2) minimize toxic releases into the environment.

More than 30 faculty members are involved in GDI research and education. One of Carnegie Mellon's specialties is developing software tools to help engineers design environmentally conscious products. The following tools, developed by Carnegie Mellon, clarify economic and environmental tradeoffs associated with design choices:

- Software to help identify target areas for emission reductions using Superfund Amendment and Reauthorization Act (SARA) Title III data.

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[9] National Pollution Prevention Center for Higher Education. List-serve Notice dated July, 1996. For additional information regarding this educational tool kit, contact Montana State University Extension Service at 406-994-3451.

[10] *Pollution Prevention: Homework and Design Problems for Engineering Curricula* is available through the American Institute of Chemical Engineers at 1-800-242-4363.

Green Design Efforts at Carnegie Mellon

Research activities at CMU involve:

Green Product Design

- The environmental impacts of electric cars
- Analysis of battery life cycles
- Product design for disassembly and recycling
- Component labeling for recycling

Green Process Design

- Systematic synthesis and design methods for cost-effective waste minimization
- Optimal design and synthesis of power systems
- Development of an integrated environmental control model
- Modeling chemical emissions from fossil fuel power plants

Green Chemistry

- Environmentally benign and hydrocarbon-soluble oxidants based on transition metal chemistry

Management

- Case studies of total quality environmental management implementation
- Value chain implications for green products
- Economic models of product reuse and remanufacturing

Green Architecture

- The Intelligent Workplace: a working laboratory of environmental architecture
- Effects of lighting, zoning, and control strategies on energy use

Sustainable Development

- Planning sustainable communities
- Economic models of sustainable development

- An economic input/output life-cycle analysis tool that links economic input/output tables to environmental data bases to explore the environmental impacts of changes in production resulting from fluctuating product demand.
- An optimization package designed to find the balance between the amount of effort that is put into recycling, reusing, or remanufacturing a component or product and the corresponding environmental monetary gains.

- A design-for-recycling tool that helps assess the difficulty associated with product disassembly.[11]

Campus Pollution Prevention Programs

Campus programs go beyond curricula and research. Campus communities present a characteristic set of environmental problems and opportunities for prevention in facilities management: issues like construction and transportation, power generation, heating and cooling, food service and landscaping. On-campus programs offer a superb opportunity for students to get a concrete understanding of the challenges involved in designing and implementing prevention programs. Pollution prevention has changed the way in which campus administrators and facility managers think about the environmental impacts and economic costs associated with running colleges and universities. In order to reap the benefits of pollution prevention, many administrators realize that they must build source reduction and recycling into the fabric of campus life instead of relying solely on student organizations. Students have provided abundant enthusiasm, energy, and fresh ideas on how to make pollution prevention work both on campus and in their local communities. For their part, students are also looking to campus administrators to carry on the work begun during their years on campus.[12] For example, the University of Michigan's Pollution Prevention Masters team completed a campus-wide environmental audit and two subsequent demonstration projects.

Campus Ecology™'s Mission

To establish environmentally sound practices on college campuses by promoting leadership and action within the university community. Realizing the importance of diversity, Campus Ecology strives to include all peoples in working towards environmental solutions, and encourages joint campus and community projects. Campus Ecology recognizes the efforts of people who work on outstanding projects by documenting and publishing their accomplishments.

Begun in the early 1990s, the National Wildlife Federation's Campus Ecology™ program provides tools, guidance, and a support network to help students become involved in environmental issues on campus.[13] Campus Ecology resources include Project Resources Packets, workshops, site visits, organizing information, a *Campus Environmental Yearbook*, an environmental job bank, and a newsletter. Campus Ecology is accessible and searchable via the Internet (http://www.nwf.org/nwf/campus). The program encourages students to coordinate with administrators to develop environmental policies, campus leadership frameworks, and environmental centers.

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[11] Conway-Schempf, N., and L. Lave, "Pollution Prevention Through Green Design."*Pollution Prevention Review* (Winter 1996). pp. 11-20.

[12] Keniry, J. *EcoDemia: Campus Environmental Stewardship at the Turn of the 21st Century*. National Wildlife Federation, Washington, DC (1995).

[13] National Wildlife Federation. *Campus Ecology ™: A Campus Outreach Program of the National Wildlife Federation* (Spring 1996).

Campus Ecology projects include the following:

- The Environmental Action Committee and the Faculty of Arts and Sciences of Harvard University co-sponsored an energy competition among undergraduate houses and dorms, saving the school $500,000 in reduced energy use during a 6-month period.
- The Student Government Association (SGA) of Florida Memorial College, a private, historically black college in Miami, launched a campus wide recycling program, completing the loop by also ensuring that the procurement office bought recycled products for the SGA office. The SGA's efforts won it the Leadership for Excellence Award from the City of Miami.

George Washington University (GWU) in Washington, DC, is one of several universities that have established a "green" university vision. Unlike most universities, however, GWU signed a letter of understanding and agreement with EPA to make an environmental ethic a part of all activities of the university. The letter of agreement is based on the following seven principles:

1. Ecosystem protection
2. Environmental justice
3. Pollution prevention
4. Strong science and data
5. Partnerships
6. Reinventing GWU's environmental management and operations
7. Environmental accountability

GWU has committed to incorporating green concepts into its academic programs, research, infrastructure/facilities, environmental health services, international issues, and outreach programs. With respect to infrastructure/facilities, for example, the university's mission is to "develop and promote policies, programs, and practices that maximize the beneficial effects and minimize the harmful effects of university facilities, grounds, infrastructure, and associated operations on the environment." GWU's Goals and Strategies for Infrastructure/Facilities Management are as follows:

Long-term Goal: Establish an energy and environmental control function within the Facilities Management operating unit of the university.

Strategies:

- Create an office of Energy and Environmental Control within Facilities Operations, with appropriate personnel assignments.
- Develop an energy and environmental management objectives program with specific projects identified for implementation.

Colleges and universities also have taken the lead in developing **microscale experiments** for students in chemistry laboratories. Dr. Dana Mayo of Bowdoin College and Dr. Ron Pike of Merrimack College pioneered the first efforts to design new microscale experiments. Working with students and the Ace Glass Company in Vineland, New Jersey, the professors manufactured new laboratory equipment that reduces waste. The

results of the microscale revolution at Bowdoin College are impressive. Hazardous material use dropped from an average of 300 to 400 milliliters per student to 100 milliliters per student, and the cost of running the organic labs declined from $8,000 per lab to less than $1,000 per lab due to reduced disposal fees. An unexpected benefit was that Bowdoin students' rate of acceptance to graduate chemistry programs skyrocketed because the microscale experiments turned out to be great instructional aids.

The microscale revolution has since spread throughout the United States and overseas. Rice University is phasing in microscale experiments for its 250 undergraduate chemistry students. Similarly, the University of Washington has transformed most organic experiments to microscale and has begun using products from some experiments as reagents for others. Purdue University, with the largest chemistry program in the country, started "microscaling" in the 1993-94 academic year, and the University of Michigan, which adopted the microscale approach in 1990, recently designed a new building around the program. The University of California-Los Angeles, New York University, North Carolina State, the University of North Carolina, Duke University, the University of Wisconsin system, and the Arizona State University system have all begun microscale programs within the past 5 years.[14]

Technical Assistance Program Elements

- Information clearinghouse
- Research and development
- On-site technical assistance
- Waste exchange
- Waste audits
- Workshops and seminars
- Newsletters
- Awards programs

Technical Assistance Programs

The 1994 NPPC directory lists 38 university-based centers for pollution prevention. The centers carry out a wide variety of functions including working with industry on research and development of pollution prevention technologies, technical assistance and outreach to small business, waste reduction audits, data collection, pollution prevention training, and conferences. University-based centers for pollution prevention complement similar work being carried out by trade associations and nonprofit organizations such as the Institute of Advanced Manufacturing Sciences and the Pacific Northwest Pollution Prevention Research Center.

Many pollution prevention centers receive state or federal funding and work with environmental regulatory agencies to provide technical assistance to local businesses. One of the many benefits from these programs is that businesses tend to feel more comfortable inviting university students to conduct waste audits than staff from a regulatory agency. Many states have both compliance assistance/pollution prevention coordinators in the environmental regulatory agency and a technical assistance program in a university.

The Internet has become a vital mechanism for exchanging information related to pollution prevention. As facilities carry out pollution prevention strategies, the need to share solutions for specific problems has intensified. In the mid 1990s the University of Wisconsin's Solid and Hazardous Waste Education Center created a list-serve (a specialized/limited access bulletin board or chat room) on the Internet called P2TECH. P2TECH serves as an information sharing forum for pollution prevention

[14] Keniry, J. *EcoDemia: Campus Environmental Stewardship at the Turn of the 21st Century*. National Wildlife Federation, Washington, DC (1995). pp. 160-164.

technical assistance providers. The goal of the Wisconsin program is to foster information exchange by making it easy for pollution prevention information to be distributed. List-serve subscribers post questions to the E-mail address: p2tech@great-lakes.net. The question is automatically forwarded to other subscribers. If any other subscribers know the answer to questions they receive, they can respond directly to the sender or can post a response on P2TECH. P2TECH has more than 300 subscribers and the number of participants is growing.

List-serves on the Internet

The University of Wisconsin's Solid and Hazardous Waste Education Center created a list-serve on the Internet called P2TECH, that allows subscribers to exchange pollution prevention technical assistance. Subscribers can post questions to the e-mail address: p2tech@great-lakes.net and other subscribers can respond directly to the question sender. Similar list-serves are available for pollution prevention regulations (P2REG), training (P2TRAINER), and pollution prevention for the printing industry (PRINTECH).

Similar list-serves are available for discussing pollution prevention regulations (P2REG), training (P2TRAINER), and pollution prevention for the printing industry (PRINTECH). List-serves have proven to be an extremely useful method of sharing ideas on vendors, problem-solving approaches, and information sources. The majority of participants are state technical assistance providers but a growing number of consultants and federal facility coordinators also have joined.

The University of Massachusetts-Lowell has developed and maintains the Toxics Use Reduction Institute (TURI). TURI is a multidisciplinary research, education, and policy center that sponsors and conducts research, coordinates training programs, and provides technical support to promote education in the use of toxic chemicals. One of TURI's most ambitious projects is P2 GEMS (http://www.uml.edu/turi). P2 GEMS is an Internet search tool for facility planners, engineers, and managers who are looking for technical and process/materials management information. The site is full text searchable and includes documents, citations, names of experts, and other resource material designed to assist users in pollution prevention efforts.

In many states, universities are the principal providers of technical assistance to the agricultural community. For example, the national Farm*A*Syst program is housed at universities. Farm*A*Syst helps farmers and ranchers identify pollution risks from nitrates, microorganisms, and toxic chemicals. This program provides both fact sheets that describe legal and technical requirements in a format that non-experts can understand and step-by-step worksheets to help landowners apply this knowledge to their property. Ultimately, Farm*A*Syst increases use of site-specific management practices that prevent pollution. The national headquarters of this program is located at the University of Wisconsin in Madison.[15]

[15] Webpage for Farm*A*Syst. (www.wisc.edu/farmasyst)

Partnerships in Pollution Prevention

The growth of pollution prevention research at universities and colleges has been helped by partnerships between business/industry and educational institutions. In many instances, the business community has been a significant funding source for university research efforts. For example, the University of Illinois Center for Waste Management and Research, the University of New Orleans (Urban Waste Management Center), Michigan Technological University, Eastern Michigan University, New Mexico State University, Clarkson University, and the University of North Dakota have all received funding for their pollution prevention programs from industry.

Businesses and universities are also working jointly on pollution prevention projects. One partnership combines the resources of the University of Tennessee, EPA, and Saturn Corporation to develop a "green" automobile through a cradle-to-grave study of automobile manufacturing. The goal of the partnership is to incorporate environmental concepts in design criteria and eliminate pollution from the manufacturing process.[16] University of Tennessee experts will help Saturn develop computer programs to assess the environmental impact, performance, and economic feasibility of different designs and manufacturing materials.

The Department of Energy also has reached out to the university community to help achieve pollution prevention. DOE has established Energy Analysis and Diagnostic Centers at universities like Oklahoma State University, where students and engineering faculty conduct no-charge energy analyses for private companies. By the close of 1994, more than 5,000 assessments had been conducted and manufacturers had saved over $500 million and 94 trillion British Thermal Units of energy. The result was a decrease in the emission of harmful greenhouse gases by 200,000 metric tons.[17]

In addition to weaving pollution prevention into the fabric of the campus environment and curricula, universities are bringing pollution prevention into their surrounding communities. Pollution prevention is a way of bridging the gap between academia and town residents as both sides work to protect the local environment. Students and faculty have undertaken many different types of outreach projects ranging from courses incorporating Community Right-to-Know data at Dickinson College to fireside chats about "living lightly" at Northwestern University.

Professor Michael Heiman at Dickinson College in Carlisle, Pennsylvania teaches students how to use information in EPA's Toxics Release Inventory (TRI) to identify companies' toxic chemical releases to the environment.[18] Dickinson students tour facilities, meet with union officials and community residents, and then prepare environmental and epidemiological profiles on the chemicals they track. Students have

What students have learned at Dickinson, they are giving back to their communities. In the end, explains Professor Michael Heiman, "we are dedicated to bring science to the impacted community and assisting local residents, many of whom may not have had the chance to go to college, to monitor the local environment by (and for) themselves."

[16] Enviro$ense: Pollution Prevention Advisor (First Quarter 1996).

[17] U.S. Department of Energy, Office of Industrial Technologies. "*DOE's Industrial Assessment Centers,"* (October 1995).

[18] Keniry, J. *EcoDemia: Campus Environmental Stewardship at the Turn of the 21st Century*. National Wildlife Federation. Washington, DC (1995).

audited pulp and paper mills, lead battery recyclers, a soup company, marine boat manufacturers, oil refineries, petrochemical companies, and many others. They also have used the TRI data base to help affected communities identify toxic waste by plant, chemical, and amount shipped offsite to specific waste disposal facilities, as well as to track toxic emissions into specific bodies of water and sewage treatment plants.

Recognizing the community empowerment aspects of Dr. Heiman's project, EPA Region III awarded Dr. Heiman and his students a grant in 1994-1995 to conduct 18 TRI data access workshops for local grassroots environmental groups from low-income neighborhoods and communities of color.

Students at Northwestern University in Evanston, Illinois, have involved both the campus community and residents of the city surrounding the campus in environmental protection through pollution prevention. Students for Environmental and Ecological Development (SEED) promotes concern for the planet in community decisions and in daily life both through education and action. Two of SEED's most recent projects are Garbology 101 and Living Lightly.[19]

- Garbology 101 is a demonstration and experiment, which SEED conducts annually. Students are given two clear plastic bags to collect their trash and recycling for a week in order to get an accurate account of how much waste they produce. At the end of the week, participants weigh their garbage. After participating in this activity, students are often more motivated to reduce their waste generation.
- Living Lightly is a project to show people in the Northwestern surroundings how they can place fewer demands on habitats and resources. The main activity is a series of "firesides," which are held in dorms on campus. SEED's home page on the Internet lists several references that discuss pollution prevention tips.

NWF's 12 Benchmarks for Success

1. Identify and establish executive support.
2. Develop a written policy.
3. Identify and maintain resources and incentives.
4. Create a structure (committee/taskforce).
5. Integrate programs into the curriculum.
6. Conduct pollution prevention research.
7. Incorporate pollution prevention into planning and design.
8. Establish a sense of community.
9. Measure reductions and demonstrate successes in waste reduction and cost savings.
10. Publicize the program.
11. Extend environmental ethic to all business activities.
12. Promote leadership development and training.

Ecodemia -- The National Wildlife Federation.

[19] SEED's home page can be accessed through EPA's Enviro$ense site (http://es.inel.gov).

As university programs continue to grow in both size and scope, it is important to develop a plan that ensures success. The National Wildlife Federation has developed a set of 12 benchmarks for the successful development and implementation of environmental programs, which can be used in pollution prevention programs.

Reaching Out to Community and Technical Colleges

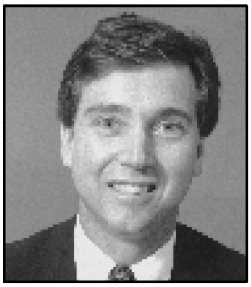
EPA's Office of Pollution Prevention and Toxics (OPPT), through its Design for the Environment (DfE) Program, and the Partnership for Environmental Technology (PETE) have combined efforts to create the OPPT-DfE-PETE Environmental Education and Training Alliance. PETE helps community and technical colleges in developing and delivering quality education and training programs that address the nation's environmental workforce training needs, particularly at the technician level. Begun in 1990, the PETE network currently consists of six regional partnerships serving all 50 states through approximately 400 participating colleges. DfE and PETE are coordinating several activities including developing DfE-P2 training courses to complement existing industry training programs in fabricare, printing, and metal finishing.[20]

Conclusion

Pollution prevention activities have only recently arrived at educational institutions, and it is only in the last couple of years that preventive concepts such as source reduction and waste reduction have really taken hold, claiming an equal place with conservation, recycling, and environmental studies. Considering how recent they are, much has been accomplished, particularly in university R&D and in campus programs to reduce waste generation, only a few of which could be highlighted in this chapter. Pollution prevention curriculum development has been proceeding quickly in the last few years, but is nowhere near standard fare at most universities. Networking and exchange of curricula among university faculty is also still at an early stage.

Several lessons learned from the last few years are worth repeating. First, pollution prevention's arrival on campus injects a "real-world" component into university courses — from business school to engineering — that benefits students, faculty, and partnering organizations. Second, as noted earlier and as Jonathan Bulkley underscores in one of the Guest Comments that follow, students have played a decisive role in awakening universities to the "green" revolution. That in itself is cause for celebration, but it also means, as David Allen notes, that the gains achieved on a few campuses must be institutionalized and broadened if they are to take hold and flourish.

[20] For more information on the PETE-DfE alliance contact: David Y. Boon, PETE-DfE Manager, Front Range Community College, Westminster, Colorado.



Pollution Prevention and Educational Institutions: Next Steps and Long-term Needs

by
David Allen
Beckman Professor of Chemical Engineering
Center for Energy Studies
The University of Texas at Austin

Exciting activities are underway in curriculum development, technical assistance, and campus ecology. While I am very enthusiastic about these activities, I do have concerns about their long-term viability.

Most pollution prevention efforts at universities and other educational institutions have been the result of grassroots efforts. Dedicated individuals or small groups, working in isolation, have generally been responsible for the activities that are cited in the report. There are, of course, exceptions. The program at Tufts University, which has had support from the highest levels of the University Administration, and which has permeated the entire campus, is a dramatic counter example. Still, most of the efforts are the result of individuals, and they can disappear as quickly as they appeared. Therefore, the next step in promoting pollution prevention at educational institutions should be to encourage long-term commitments to pollution prevention. These commitments could be encouraged in many ways. Let me suggest some ways to encourage engineering programs to make such long-term commitments:

(1) Have employers demand that the students they hire understand pollution prevention principles.

(2) Have accrediting boards look for pollution prevention and design for the environment activities in degree programs.

(3) Have new editions of leading textbooks for each discipline incorporate pollution prevention.

There are just a few simple, self-evident suggestions. My main point is that pollution prevention at educational institutions needs to enter a new phase in its development. The past decade has shown us that successful programs in curriculum development, technical assistance, and campus ecology can be developed. The goal for the next decade should be the make these activities the rule, not the exception. Accomplishing that goal will require new approaches.

Student Efforts and Grassroots Initiatives

by
Michael Heiman
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Carlisle, Pennsylvania

Despite growing recognition of the need for routine environmental monitoring and enforcement, we live in an era of limited state and federal resources. Fortunately, community residents can be trained to directly access the regulatory and reporting data required from hazardous chemical generators, handlers, and emitters. Through further assistance and access to laboratory facilities of the type common on many college and university campuses, local volunteers can also assist in the detection and monitoring of contaminants in their communities. With pollution prevention beginning at the neighborhood level, in our homes through consumption choices, and at work through production decisions, public access to emission data and lay participation with routine background environmental monitoring are essential prerequisites if we as a society are to move toward a more sustainable relationship with the environment.

Congress specifically intended the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) to enable citizens to learn more about the hazardous chemicals stored, used, and released in their communities. The EPCRA Toxic Release Inventory (TRI) database provides the major vehicle whereby thousands of environmental activists and toxic victims are finally gaining a handle on the chemical risks to which they are exposed. The result has been a flurry of grassroots activities leading to widespread popular support for toxic use reduction and more democratic participation in local planning and zoning decisions affecting facility location and expansion. At the national level, access to the TRI data base builds political pressure necessary to strengthen federal environmental acts promoting pollution prevention and toxic use reduction, and expanding the list of regulated chemicals under the Clean Air and Clean Water Acts.

The Environmental Studies Program at Dickinson College in Carlisle, Pennsylvania, is committed to this goal of grassroots empowerment through faculty and student outreach to affected communities. This is demonstrated through our Community Toxic Waste Audit Program and the Alliance for Aquatic Resources Monitoring (ALLARM). Both employ Dickinson students working with community volunteers to address requirements for hands-on training in TRI data acquisition and with routine environmental monitoring.

The toxic waste audit process is initiated each spring as 75 students in our introductory environmental science course prepare audits on communities or facilities of their choosing. The emphasis here is on data acquisition and, through plant tours and interviews with production managers, on information concerning progress toward pollution prevention, in-plant recycling, and toxic use reduction. The result is that we now run one of the largest campus-based toxic waste audit programs in the nation drawn from the TRI data base, and our activities have attracted regional and even national attention.

Supported in 1994-95 by an Environmental Justice Grant administered by EPA Region III, my students and I conducted a series of TRI-access workshops in communities of color and low-income neighborhoods heavily impacted by toxic emissions. The response was overwhelming. Growing demand for the workshops led us to

prepare a training video geared to accessing the CD-ROM format of the data base, a format that lower-income residents are more likely to access at local libraries that often lack on-line resources. The data accessed are being put to good use in communities such as South West Philadelphia, where a dialogue was initiated with the major oil refinery in the region. Most manufacturing concerns prefer to converse with a knowledgeable and informed public. Thus negotiations on pollution prevention, source reduction, and a "good neighbor agreement" leading to community monitoring of production emissions, are greatly enhanced when each side is apprised of the level of information available to the other. We are convinced that the TRI data base remains the single most powerful, yet accessible, source of information in the quest for environmental justice, toxic use reduction, and community environmental empowerment.

It is one thing to access industry's self-reporting via the TRI data base, and quite another to actually monitor the environmental quality around a major point of discharge. Community environmental monitoring has grown to encompass many thousands of volunteers across the nation. Today there are over 500 groups listed in the EPA's *National Directory of Volunteer Environmental Monitoring Programs (4th*edition, 1994, Office of Water), the majority in existence only since 1990. Often with state and federal financial support, volunteers are trained by non-profit service programs such as the Save our Streams Program of the Izzak Walton League. Colleges and universities also play a central role, both with training for routine monitoring of pollutants, and with the identification of environmental quality indicator species such as macroinvertebrates. Institutions of higher education can also assist with community access to more advanced analytical equipment for detection of pollutants collected by trained local volunteers.

At Dickinson College, ALLARM, founded by Professor Candie Wilderman, runs one of the largest volunteer monitoring programs in the nation. Staffed by students, ALLARM involves over 500 local participants across Pennsylvania who test weekly for acidity and buffering capacity in their local streams. ALLARM staff can supply a "toxic fingerprint" for heavy metals and hydrocarbons based on water samples collected by local volunteers, with the results helping to identify water discharges that may not appear on the TRI reports. With appropriate quality control assurance, and providing a much denser spatial and temporal matrix of sampling sites than possible with over-taxed public agencies, many states have come to rely upon volunteer monitoring to meet the biennial water quality reporting requirements of section 305(b) of the Clean Water Act.

Encouraging our students to work as multidisciplinary research teams in a real-world setting; helping them acquire both technical skills and social self-confidence as they network with industry, residents, labor, and regulatory personnel; and building bridges between the campus and the wider community, are critical goals for our program. We are convinced that colleges and universities have a vital role to play as they assist local communities and organizations download existing information and monitor the background conditions necessary to measure progress toward pollution prevention and toxic use reduction.

Pollution Prevention and the Challenge for Higher Education

by
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National Pollution Prevention Center
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Environmental protection efforts on campuses have been developed in many different ways over the past five years. My direct experience has been conditioned by what I have observed as a faculty member at the University of Michigan. At the same time, as Director of the National Pollution Prevention Center for Higher Education, there have been opportunities to gain appreciation of what is taking place on other campuses around the country. One common thread, which it is important to highlight is the increased awareness of and commitment to pollution prevention by the students in a wide range of disciplines. This awareness of and commitment by students manifests itself in a variety of ways. For example, student project teams have examined pollution prevention and waste reduction opportunities at different locations both on-campus and off-campus ranging from implementation of chemical tracking systems at universities, pollution prevention and waste reduction initiatives for an entire school within a major university, to pollution prevention and waste reduction opportunities for major collegiate sporting events, and less polluting alternatives for dry-cleaning. The students and faculty who undertake these and many similar types of projects demonstrate the vitality of promise of pollution prevention activities at colleges and universities across the country.

In my view, certain pollution prevention and sustainable development activities in industrial settings have moved ahead of the present curriculum in many colleges and universities. In part, this is the result of the economics associated with waste clean-up and other associated liabilities. Accordingly, it is desirable for colleges and universities to establish enhanced linkages with pace-setting industrial locations where very innovative and creative pollution prevention activities are underway. The linkages can take a variety of forms including joint faculty-industry research efforts, student pollution prevention internships with industry, faculty joining industry for special projects/tasks, and industry leaders teaching innovative courses at colleges and universities.

One specific example of this type of industrial leadership is in the development of the concept of Industrial Ecology. While the origins of Industrial Ecology may be traced to the systems approach to problem formulation and problem analysis, the specific concept is attributed to Robert Frosch and Nicholas Gallopoulos from the General Motors Corporation, in their article, *Strategies for Manufacturing,* (Scientific America 261; September 1989, 144-152). At the time, Robert Frosch was a Vice-President of General Motors; now, he is a faculty member at the Kennedy School of Government, Harvard University. A team led by Dr. Thomas E. Graedel at Lucent Technologies (Bell Laboratories) has been very instrumental in the substantive development of the concept of Industrial Ecology and its application in real world settings. In addition, Dr. Graedel and Dr. Allenby, also of Lucent Technologies, have published the first textbook on Industrial Ecology and it is being used at several universities (Graedel, T.E. and Allenby, B.R., Industrial Ecology, Prentice-Hall, New York, 1995). Through the innovative support program of the AT&T Education Foundation, a number of key Industrial Ecology initiatives at colleges and universities in this country and overseas

have been implemented. This type of creative and constructive activity between colleges/universities and industry need to be emulated and expanded.

In undertaking the implementation of pollution prevention programs, colleges and universities have both unique opportunities and unique challenges. On the one hand, there is an able and active student body whose interests and energy is ready to help advance such programs. As with any institution, there are other real forces which act to inhibit change and the implementation of new ideas and concepts. Faculty members may want to alter their courses to include new concepts on pollution prevention and sustainable development. However, these new materials need to be provided to the faculty in ways which facilitate the utilization of these new materials by the faculty member. Constraints associated with meeting accreditation requirements may limit the rate of change of introduction of pollution prevention/sustainable development curricular materials into such accredited programs. Faculty research opportunities in pollution prevention/sustainable development from funding sources such as the National Science Foundation (NSF) and other key institutions funding research need to be established and extended. In the long term, the compiling of research activities and curricular development results in the enhanced education of students in the area of pollution prevention/sustainable development. These students will then bring these ideas/concepts to their workplace and the likelihood of significant progress being made will be greatly enhanced.

From a personal view, on this campus there are two pollution prevention activities which I have observed that are both exciting and productive. First, in a number of sponsored research pollution prevention projects, a diverse group of students have come together to work in a very productive and useful way. The key to this success is the leadership offered by the director of the research effort. Through leadership and excellent insights, the research team leader sets the example that draws the very best efforts from all who work on the research projects. These research efforts stand as excellent examples of the creative and constructive results that can be achieved in this field.

A second example again relates to students. In this case, the NPPC has experience with the placement of pollution prevention interns in industry, not-for-profit organizations, and government. The quality of effort by these young people from a variety of backgrounds, disciplines, and universities has clearly demonstrated that a group of exceptionally talented and capable young people are coming forward to work and help solve these problems that need pollution prevention and sustainable development concepts and approaches. I am very optimistic that the students of today who will be the leaders in the twenty-first century will rise to the challenges and provide pathways to achieve pollution prevention and sustainable development.